The Impact of Structure and Meaning on Sequential Image Comprehension

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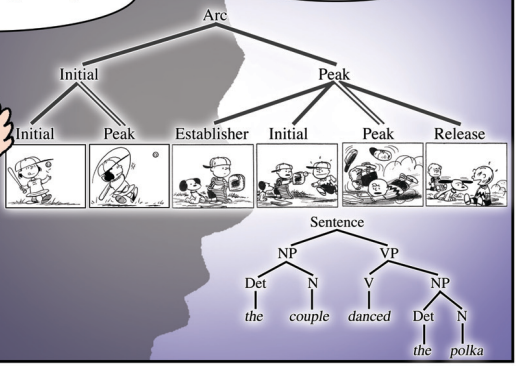
Just as syntax allows us to differentiate coherent sentences from scrambled strings of words, the comprehension of ***sequential images*** must also use a cognitive system to distinguish a coherent narrative sequence from a **random** string of images.

Such a structure in the graphic domain would parallel ***grammars*** in the other conceptual expressive modalities of verbal and manual languages.



We conducted experiments analogous to two classic studies of syntax to examine the effects of ***structure*** in processing sequential images...

... for which four types of novel 6-frame long comic strips were created (160 sets) using individual panels from Charles Schulz's *Peanuts*:

1) Normal sequences with both narrative and meaning.

2) Semantic Only – with semantically related panels but no narrative.

3) Structural Only – with a narrative arc (3) but no coherence between panels.

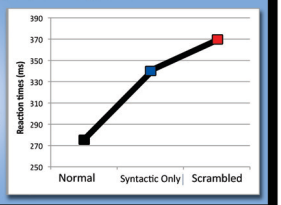
4) Scrambled – sequences of randomly-ordered panels.

Target Panels

Experiment 1: Target Monitoring

In a classic study of language comprehension, Marslen-Wilson et al. (1) showed syntactic structure gave an advantage in reaction times (RTs) for target words in...

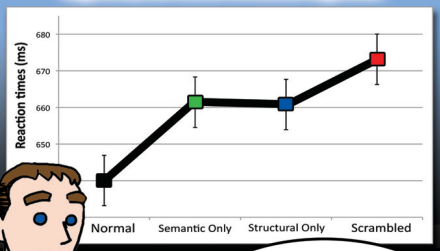
(a) normal sentences
(b) syntactic sentences with no meaning ("Colorless green ideas...")
(c) scrambled sentences



Imitating this study, our participants monitored target panels (counterbalanced across conditions) in sequences presented one frame at a time (1500msec presentation, 300ms ISI).

54 comic readers (30M, 24F), mean age: 20.4
Mean Expertise*: 13.89

RTs to target panels were slowest in Scrambled sequences, intermediate in both Structural Only and Semantic Only sequences, and fastest in Normal sequences.

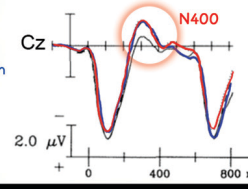


These results suggest that the semantics of individual panels and overall structure across panels each offer advantages to sequential image processing.

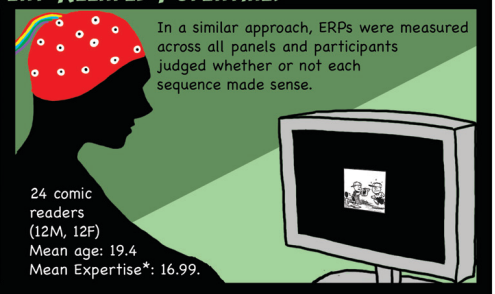
Experiment 2: Event Related Potentials

An ERP study (2) using verbal similar stimuli found a larger N400 to words in scrambled and syntactic-only sentences than in **normal** ones, suggesting that without semantics, syntax could not reduce the N400 amplitude — a waveform sensitive to semantic processing.

(a) normal sentences
(b) syntactic sentences with no meaning ("Colorless green ideas...")
(c) scrambled sentences

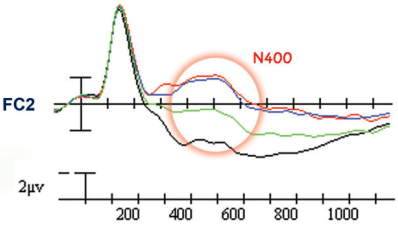


In a similar approach, ERPs were measured across all panels and participants judged whether or not each sequence made sense.

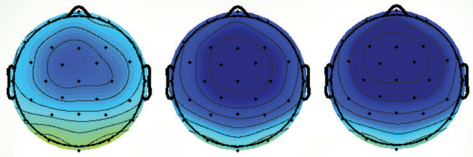


24 comic readers (12M, 12F)
Mean age: 19.4
Mean Expertise*: 16.99.

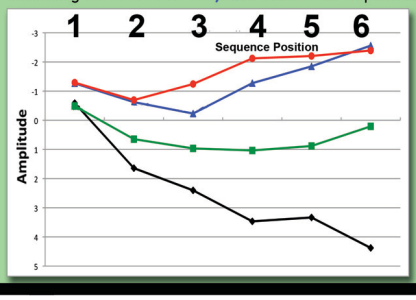
The N400 to target panels was largest in both Scrambled and Structural Only sequences, intermediate in Semantic Only sequences and smallest in **Normal** sequences.



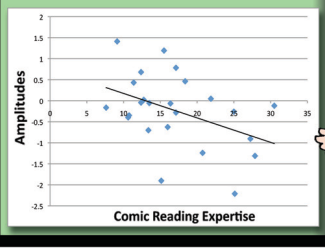
Consistent with previous studies of image processing (4), this N400 effect had an **anterior** distribution.



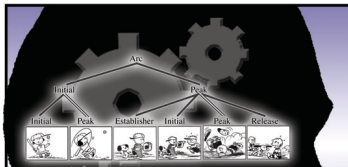
Also, the amplitude of the N400 decreased across ordinal position of panels only in the **Normal** sequences, increasing in Structural Only and Scrambled sequences.



Finally, a correlation found that the voltage difference between Structural Only and Scrambled sequences showed greater separation for participants with greater Comic Reading Expertise.

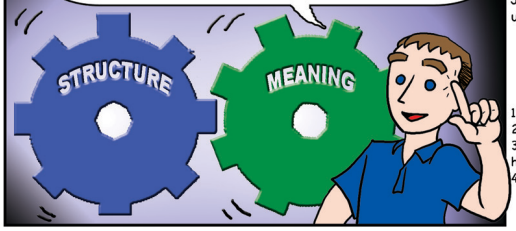


Overall, these ERP results suggest that the processing advantage gained from structure, in the absence of semantics, had little impact on reducing the N400.



Taken together, these findings suggest that sequential image comprehension uses a ***global grammar*** that extends beyond semantic associations between individual frames and is modulated by fluency in its structure, similar to language.

We suggest that the comprehension of graphic narrative is guided by an interaction between ***structure*** and ***meaning***, akin to that between ***syntax*** and ***semantics*** in language.



Appendix

* Comic Reading Expertise was calculated using a pretest questionnaire asking how often participants read a variety of forms of comics on a scale of 1 to 7 (comic books/sequences, graphic novels, Japanese comics, etc.), both as a child and adult. A score was given using this formula:

$$\left(\begin{array}{c}\text{Mean Comic reading frequencies} \\ \times \text{ Comic reading expertise}\end{array}\right) + \left(\frac{\begin{array}{c}\text{Comic drawing frequency} \\ \times \text{ Drawing Ability}\end{array}}{2}\right)$$

References

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